ENERGY **4** IMPACT
ACCELERATING ACCESS TO ENERGY

IMPACT OF IMPROVED INSTITUTIONAL COOKSTOVES (IICS) IN UGANDAN SCHOOLS

A STUDY OF 10 DISTRICTS AND THE EFFECT OF ENERGY 4 IMPACT'S PROGRAMMES

BY MAKENA IRERI & SIMON COLLINGS

LIST OF FIGURES

TABLES

ACRONYMS & DEFINITIONS

CARE2 - Capital Access for Renewable Energy
E4I - Energy 4 Impact
EBD - Energy Business for Development
IICS - Institutional Improved Cook Stoves
M&E - Monitoring and Evaluation
MFI - Micro Finance Institution
MoEST - Ministry of Education, Science, Technology and Sports
MSMEs - Micro, Small and Medium sized Enterprises
PDP - Pipeline Development Projects
SACCO - Savings and Credit Cooperative
SMEs - Small and Medium Enterprises
UGX - Ugandan shilling
USD - United States Dollar

School term: for Uganda, this equates to 3 months
Stove: one pot opening on IICS counts as one stove
E4I schools: schools that E4I has documented as having acquired IICS through E4I's programmes

EXECUTIVE SUMMARY

Since 2013 Energy 4 Impact has been running programmes in Uganda that directly and indirectly targets the adoption of Improved Institution Cookstoves (IICS) in schools. Towards the conclusion of the latest intervention, it was crucial to 1) review underlying assumptions and the justification for continued action, 2) assess impact, and 3) highlight challenges and opportunities for the future. A study was therefore commissioned with those objectives.

The study found evidence of significant uptake of IICS amongst schools targeted by the E4I programme. In addition to the 441 schools E4I knew had installed stoves, there are approximately 871 other schools which have IICS, with somewhere between 286 to 596 of these schools having installed them during the period E4I's programme was operating. It is possible that many schools which installed IICS but were not recorded as having done so by Energy 4 Impact, acquired stoves as a result of the programme. Moreover, there is clear evidence of high demand for IICS in schools that have not yet installed.

The benefits of IICS have been quantified and verified through interviews with kitchen staff and administrators. The primary benefit is cost saving, 42% savings in fuel expenditure, on average. Time savings and health related benefits were also highly ranked. Reduction in forest destruction was particularly singled out by respondents. This was in addition to schools also mentioning environmental benefits more generally.

Affordability is the main challenge for schools and increasingly for manufacturers too. Schools need assistance in financing for stoves while manufacturers want more creative payment options for schools, which would enhance affordability and improve repayment.

'Sensitisation' of schools is a complex challenge highlighted particularly by manufacturers, and appears to be linked with mistrust from consumers who have interaction with numerous enterprises of varying credibility. Decision making around purchase of a stove is another challenge. In most cases the decision is collectively taken among a variety of stake holders which can take time or stall, if stakeholders have varying levels of awareness.

Other unexpected dynamics emerged from the study. Stove design seems to have an unforeseen disadvantage for female cooks due to the weight of saucepans and height of installation. This may be the reason for the reported changing gender dynamics in school kitchens. Improper stove usage may be contributing to the higher than expected incidence in faults and training techniques may need to be adjusted to reduce improper use.

Collecting reliable data is always challenging and some of the questions we sought to answer through the survey require further investigation. The year of installation of stoves reported by schools is unreliable so that it is impossible to establish a reliable baseline retrospectively. The survey found a much larger number of schools had installed stoves than the project team had records for. Establishing the degree to which the E4I programme prompted these installations is difficult with the data obtained from the survey.

The CARE2 and EBD programmes and their designs have been validated by results of this study. Extension of such programmes into other districts will be key to increasing adoption of IICS in Ugandan schools.

INTRODUCTION

INTRODUCTION

1.1 Background of IICS programmes in Uganda

In 2012, the Capital Access for Renewable Energy (CARE2) Programme was launched, programme activity began in early 2013. The aim of the programme was to support the growth of sustainable markets for renewable energy through micro, small and medium sized enterprises (MSMEs) and was funded by the Swedish Government. The Pipeline Development Projects (PDPs) component of CARE2 targeted the deployment of specific clean energy technologies to accelerate access to energy and was focused on different areas in 4 countries. In Uganda the main focus was on Institutional Improved Cook Stoves (IICS) in schools. Originally designed as a three year programme it was extended by one year to finish in August 2016.

Since 2015, Energy 4 Impact has been implementing the Energy Business for Development (EBD) programme, whose specific objectives are to provide access to energy to rural communities and support them in productive uses of energy.

Component 1 of the programme focused on Uganda, it included engagement with cookstove and briquette manufacturers, and schools. The purpose of the programme was to increase the adoption of improved institutional cookstoves (IICS) for schools in addition to increasing sales and job creation from the supported enterprises. The main activities in this component include providing business and technical training, mentorship, marketing, advisory services and capital access including partnerships with Financial Institutions like Post Bank and Equity bank.

The project is being implemented in the districts of Kampala, Wakiso, Luweero, Mpigi, Mityana, Masaka, Mukono, Buikwe, Jinja and Mukono and is due for completion in August 2017. The EBD programme has built on the approaches developed in CARE2.
For the purpose of this report "the programme" will be used to refer to activities under CARE2 and EBD.

1.2 Rationale of the study

As of March 2017, the programme had interacted with over 2,335 schools and documented adoption of IICS in 441. This study was carried out toward the end of EBD to quantify impact, validate understanding on the current position, and make observation of the residual barriers to adoption.

STUDY METHODOLOGY

STUDY METHODOLOGY

2.1 Study area, data and sampling

2.1.1 Study area

The study concentrated on schools within the programme's focus districts. The Districts are grouped together into clusters for the programme administration.

Clusters	Luwero	Mpigi	Mukono	Wakiso
Districts	Luwero	Mpigi	Mukono	Wakiso
	Mityana	Masaka	Kayunga	
	*Kawempe (division)	*Rubaga (division)	Jinja	
		*Kampala central (division)	Buikwe	
		*Makindye (division)	*Nakawa (division)	
*Kampala district was divided into 5 divisions that sit in the various clusters as shown above				

Table 1: Division of clusters and the districts they contain

2.1.2 Identifying study subjects

The study interviewed staff and administrators in schools within the study area to determine levels of cookstove adoption within the school population. Table 2, summarises the school population in the study area[1].

It is important to note that the data from the Ministry of Education, Science, Technology and Sports (MoEST), Uganda, captures data on schools using the Annual School Census 2015 which is based on voluntary self-reporting. Therefore there will be more schools in the population than those reported in MoEST statistics.

---

[1] *Uganda Educational statistical abstract 2015, MoEST Uganda.*

EBD Cluster	Pre-primary	Primary	Secondary	Tertiary	Total
Luwero		679	110		789
Mpigi		618	117		735
Mukono		1,053	172		1,225
Wakiso		751	132		888
Sum	710	3,101	531	175	4,517

Table 2: Population of schools in the programme's focus districts

EBD Cluster	Pre-primary	Primary	Secondary	Tertiary	Total
Luwero		172	242		420
Mpigi		339	153		492
Mukono		520	347		899
Wakiso		330	187		524
Sum	22	1,361	929	22	2,335

Table 3: Summary of count of all schools approached for IICS by E4I programmes

Table 3 summarises all the schools that the programme interacted with. These are a subset of the schools in Table 2, though E4I found many more secondary schools than MoEST public reports record. The discrepancy in MoEST data is likely the result of the 'self-reported' nature of government data gathering.

Due to the incompleteness of the government published data on the school population, the research team concluded that it would be difficult to perform a statistically valid sampling of all schools in the focus districts. Therefore the study used Table 3 (schools contacted by E4I) as the population and randomly sampled within this. All of these schools were exposed to the IICS promotion activities carried out under CARE2 and EBD and therefore form a coherent population.

A proportion of the schools in the population were known to have adopted IICS from project records. A further subset of the schools were expected to have adopted IICS but unknown to E4I. The groups within the population surveyed by the study were:

Unknown Schools
    a) Group 1: Schools without IICS of any kind.
    b) Group 2: Schools with non E4I-IICS.
Schools in E4I database with IICS from E4I manufacturers
    c) Group 3: Schools with E4I-IICS.

2 Dis-aggregated 2015 figure not available, Figure from Uganda Education Statistical Abstract 2011
3 Figure for 2015 not available, figure used is from Uganda Education Statistical Abstract 2011. This includes post-primary, non-formal and formal tertiary institutions.

2.1.3 Study size and data sampling

Study sample sizes were calculated to maintain a confidence level of 95% with a 5% confidence interval. To be able to fulfil the objectives of the study, it was necessary to segment the population into schools known to have installed stoves as a result of the programme, and schools visited during the programme where the status was unknown.

Description	Segment	Total	Sample size
Population of schools contacted by E4I	Group 1,2 &3	2335	
	Group 1 and Group 2	1894	319
	Group 3	441	194
Total Study size			**513**

Table 4: Study sample sizes

Data from Group 1 and 2 was collected separately to that for schools belonging in Group 3. Random sampling was used within the two databases /segments to identify individual participants.

Other considered segmentations of the population

During the survey design process consideration was given to the possible value of a more complex segmentation into primary versus secondary and private versus government funded. This would have required larger sample sizes with significant implications for the budget. Based on data held in E4I database of schools known to have installed IICS, the conversion rates (to adopting IICS) of primary and secondary school appeared to be similar at 17% and 14% respectively. The research team decided that this difference was not marked enough to justify segmentation of the study population into primary vs secondary school. Similarly although the programme seemed to have converted more private than government funded schools, the conversion rates were 17% and 12% respectively. The research team took the view that this was also not significant enough to warrant segmentation of the population for sampling.
Ideally the study should also have included a 'control' population of schools not contacted as part of the programme. But the team took the view that this was not feasible given the inadequacy of MoEST data and the likelihood that the programme had contacted most secondary schools in the area. The population of schools not contacted by the programme would have different characteristics to those of the 'treated' population (much higher proportions of primary, as well as state funded schools) making it potentially difficult to draw comparisons.

2.1.4 Data collection

This study mainly relied on surveys delivered via in person interview to collect data from kitchen staff, school administrators and IICS practitioners. Data was collected using coded questionnaires with both closed and open ended questions.

Data was collected by enumerators and recorded directly on a tablet via standard electronic input forms. Enumerators were also instructed to make observations to verify the presence, status and use of cookstoves at the time of visit. The data collection method is summarised in Figure 1.

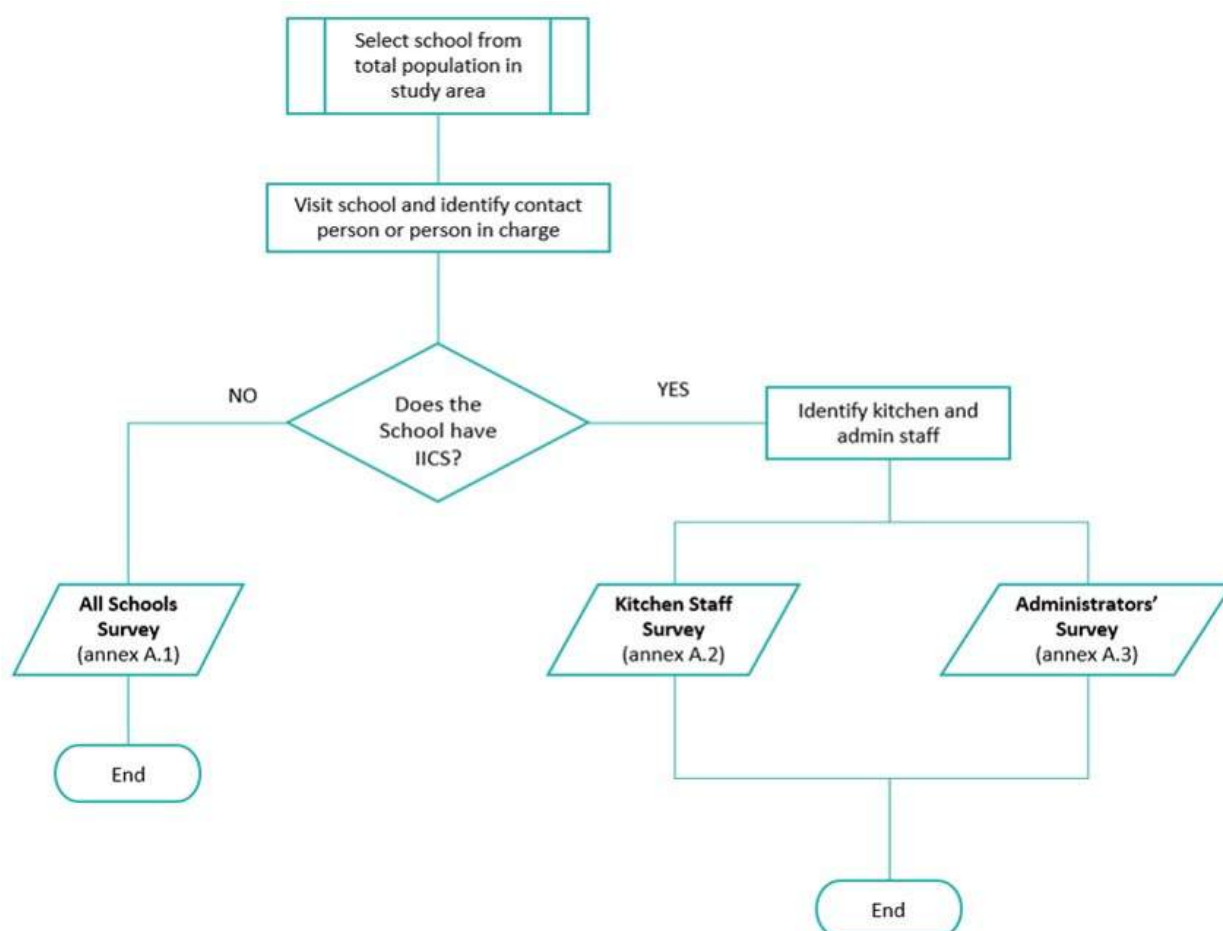*Figure 1: Study methodology flow chart – for all schools in sample population*

2.1.5 Scope and limitation

This study is limited to examination of schools within a specific area and may not be used to infer information for the whole of Uganda. The study region is relatively close to the capital city, Kampala and has different economic and infrastructure than more remote regions of the country.

RESULTS & DISCUSSIONS

Results and discussions

3.1 Data Analysis

The study on the whole followed the methodology laid out in section 2 and the number of schools surveyed is given in Table 5.

		Population	Sample of population (statistically valid)	Study Sample Interviewed	Results
With IICS-E4I (group 3)		441	194	162	148
Unknown (group 1&2)	With IICS Other	1894	319	348	160
	Without IICS				188
Total		**2,335**	**513**	**510**	**496**

Table 5: Table of samples vs result numbers separate those with IICS to the unknown

Of the 162 (group 3), 14 schools were reported not to have IICS despite being recorded as having IICS in the E4I database. These 14 schools were therefore excluded from study analysis. Further verification has revealed that there were errors in the data recorded by the enumerators for these 14 schools, only 1 legitimately did not have IICS, the rest had IICS through E4I programmes as indicated by the baseline data. These enumerator errors represent an inaccuracy of nearly 10% in the data from the study. Enumerator error is not unexpected in studies of this type and the magnitude of the errors is small enough to be considered insignificant in terms of the overall data validity.

There is correlation between the demographics of our population and those of our sample. The correlation gives confidence in the sampling technique and in the output of the study being representative of the wider population.

Group 3 - E4I schools
School type correlation:
Population (outer) vs sample (inner)
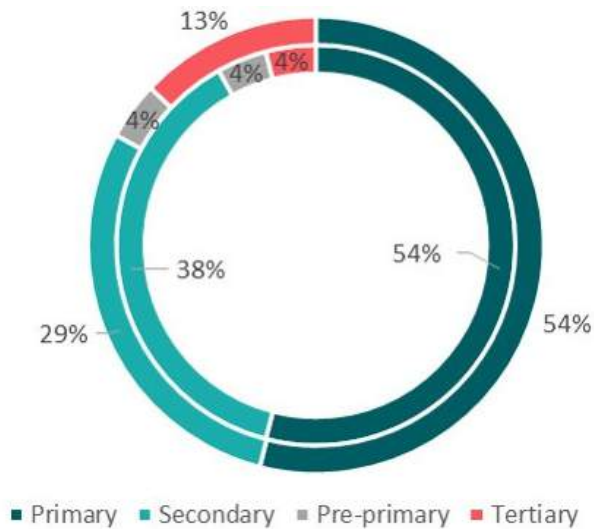
Group 1&2 - Unknown Schools
School type correlation:
Population (outer) vs sample (inner)

Figure 2: Correlation between sample groups and population (School type)

Group 3 - E4I schools
School funding correlation:
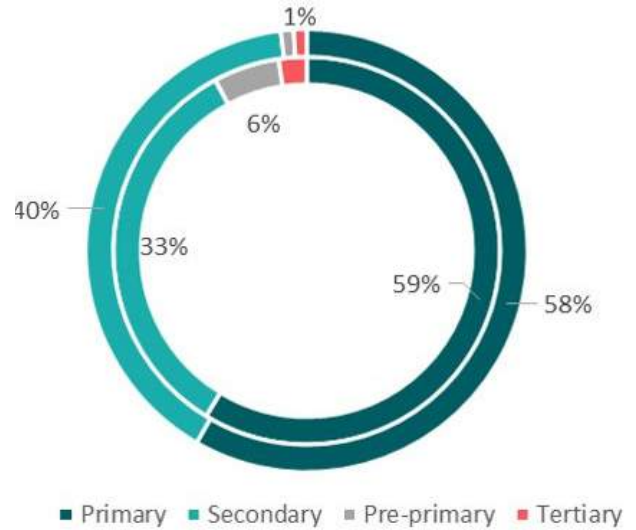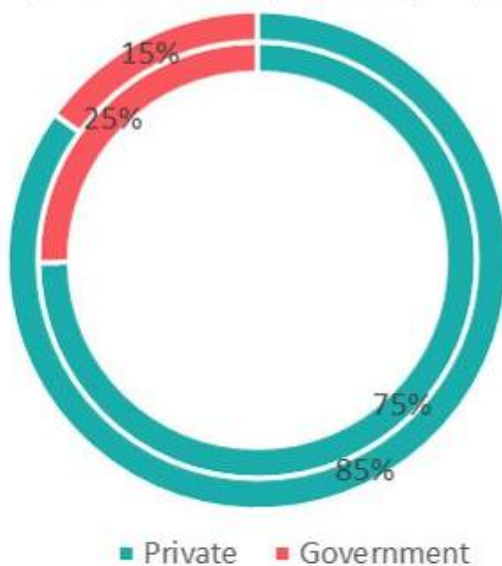*Population (outer) vs sample (inner)*

Group 1&2 - Unknown Schools
School funding correlation:
Population (outer) vs sample (inner)
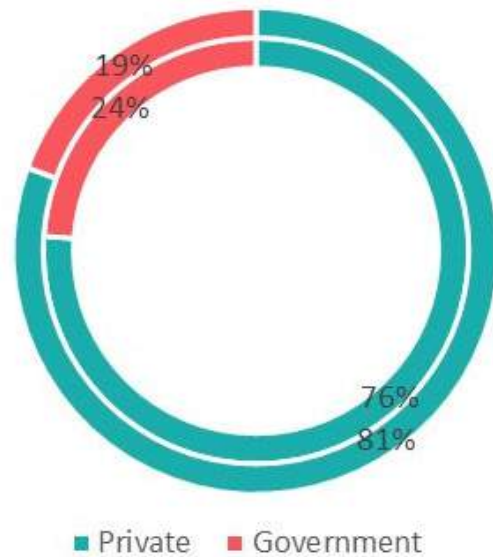
Figure 3: Correlation between sample groups and population (School funding type)

3.2 Adoption Rate and Demographics

Extrapolating from the survey data, approximately 1300 schools (56%) in the sample area have an IICS and 1023 (44%) of schools do not.

		Study Sample	Study Results	%	Translated No. in population	% of total
With IICS-E4I (group 3)		162	148		441	56%
Unknown (group 1&2)	With IICS-other	348	160 [4]	46%	871	
	Without IICS		188	54%	1023	44%
Total			496		2335	

Table 6: Adoption rates of IICS is the population

Prior to the study, E4I had recorded 441 schools who had installed/adopted IICS based on our activity in the study area. The unknown group consisted of schools that had been visited for outreach and potential IICS installation by E4I at least once in the last 4 years. Extrapolating from the survey sample results, there appeared to be around 871(37%) schools from this group with IICS where E4I was not aware that the school had installed a stove.

Before study

IICS:E4I schools
441:19%

Without IICS
1023: 44%

Unknown: grp 1&2
871:81%

Study result

IICS:E4I schools
441:19%

IICS Other
871: 37%

Figure 4: a) Penetration of IICS from E4I programmes b) proportion of adoption of IICS in E4I Schools vs others

[4] 14 schools were discounted from analysis due to enumerator error described in section 3.1

Demographics

The proportion of primary schools without IICS is slightly larger than would be expected from the proportion of primary schools in the population (66% without IICS vs 58% of primary schools in the population). The opposite is true for secondary schools, the proportion of those without IICS is lower than that represented in the total population (25% vs 40% of secondary schools in the population).
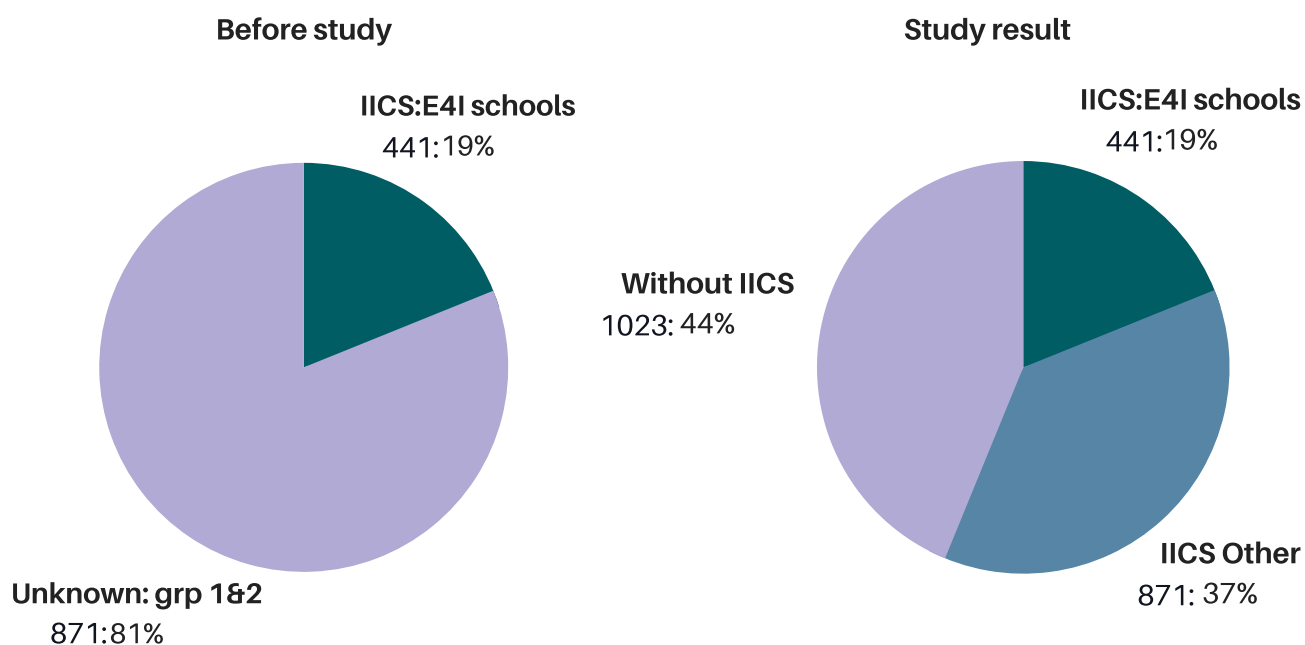
Breakdown of schools without IICS
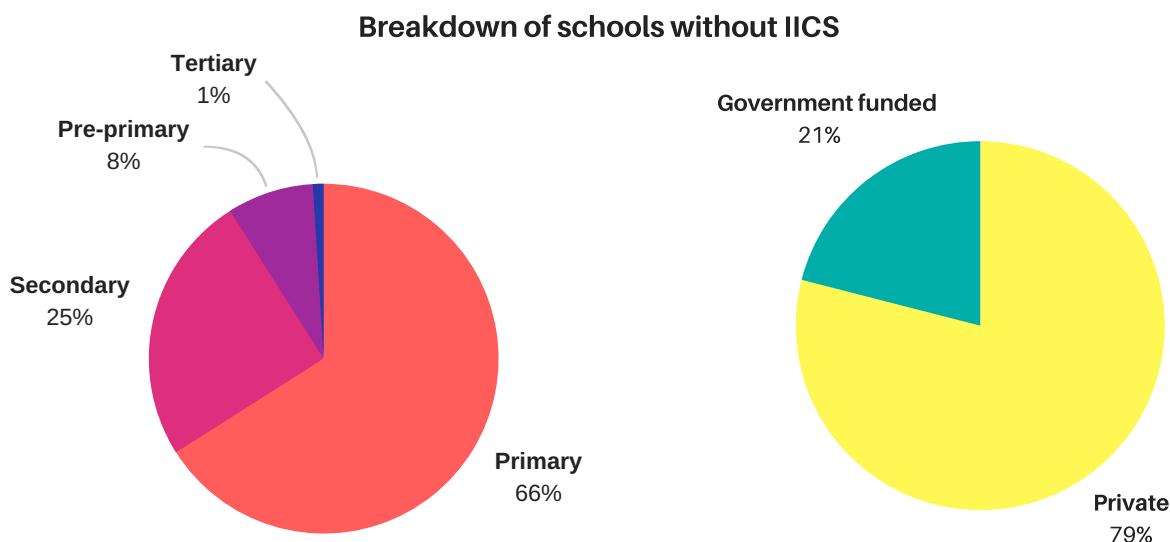
Figure 5: Schools without IICS-disaggregated by school type

Figure 6: Schools without IICS-disaggregated by funding type

It can be seen from Table 7 that primary schools have a lower conversion rate to IICS than secondary schools.

Conversion rates based on study data			
School type	E4I Schools with IICS	Other Schools with IICS	Calculated conversion rates (based on total school population)
Private	110	116	53%
Government	37	43	58%
Primary	80	81	49%
Secondary	56	68	64%

Table 7: Conversion rate to IICS for various school types

There was a disproportionately larger representation of secondary schools in the study population due to an initial strategy of targeting secondary schools for installation (see Table 3). This strategy was based on perceptions of a better value proposition for these schools owing to higher boarding school representation in secondary schools, thus more meals cooked and more potential for savings. The fact that more secondary schools were targeted may explain the higher adoption rate.

The funding type for the schools (i.e. government funded vs private), does not appear to be a factor in the adoption rate of IICS. The same proportions are roughly represented in the population.

Tertiary and nursery schools represent a small proportion of the IICS market.
There are also no significant demographic differences between schools who acquired cookstoves through E4I programmes and those who did not. i.e. The same proportions of government vs private and primary vs secondary schools were observed.

3.3 Schools without IICS

3.3.1 Cooking features

On average schools without IICS cook 2 or 3 student meals a day and spend on average 2-3 hours cooking each meal, meaning kitchen staff would spend from a minimum of 4 hours up to a maximum of 9 hours in the kitchen.

92% (172) of respondents have a designated indoor cooking area and the main mode of cooking is open fires (73%-136) and small traditional stoves (23%-43). In the study area, the hypothesis of non-adoption due to inadequate kitchen spaces is not supported by evidence.

The bulk of the schools use firewood (90%-166) with the rest using charcoal, briquettes or a combination of these. The firewood is mainly purchased locally (89%-164) though some schools supplement this by collecting locally and also asking students to bring firewood to school.

3.3.2 Reasons for the non-adoption IICS

A majority of schools interviewed reported that they had considered installing IICS (85%-155). The reasons given for not installing are explored below.

1. Cost
The biggest reason for not acquiring IICS, as reported by school administrators, is cost (47%-154 instances).

> "I would consider buying
> at reduced costs."

HEAD TEACHER, KIRA SECONDARY SCHOOL

This correlates with qualitative interviews with IICS manufacturers. When they were asked "What could help you sell more IICS in schools?" 35% (7 out of 20) of the responses included provision of additional funding to schools. A third of practitioners offered solutions for cost barriers, these included ideas such as changing payment mechanism (1), subsidize the cost for schools (2), and availing cheaper loans/ financing options to schools (4)

"IICS are good but expensive."

DIRECTOR, SEETA JUNIOR PRIMARY SCHOOLL
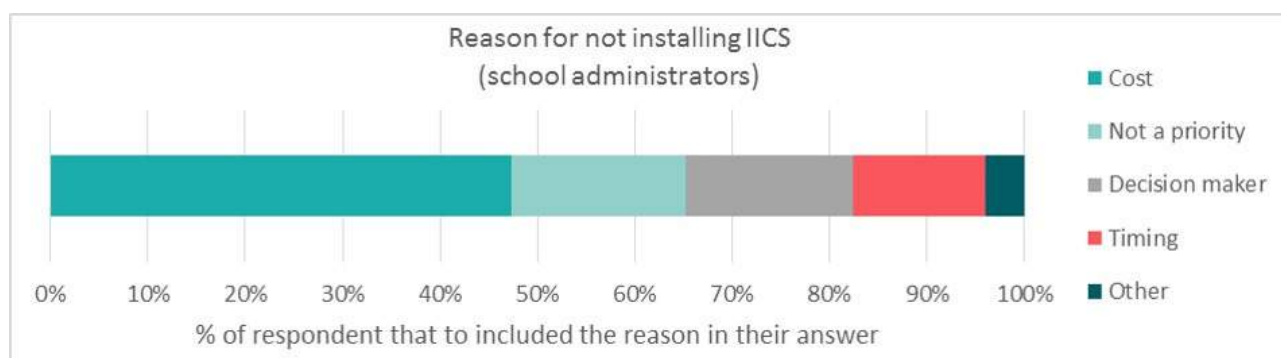
Figure 7: Reason for not installing IICS-(school administrators)

Inability of schools to pay for IICS is the biggest reported barrier to adoption.

2. Decision making, priorities and timing

The other top 3 contributors to schools not acquiring IICS are decision making power of administrators (17%- 56 instances) and competing school priorities (18%-58 instances) which is closely linked to inappropriate timing (14%- 44 instances).

The decision to purchase IICS is often a consultative process with other school stakeholders (see section 3.4.3). Many schools may not have acquired IICS because they are waiting for or deliberating the decision among stakeholders. If some stakeholders have low awareness, then this could jettison the acquisition process. The solutions may be to arrange full stakeholder meeting at the time of first or second discussions with schools, this may shorten the decision making process and address awareness gaps.

Schools will always have high and conflicting demands on limited resources, IICS may not be a priority if extra classrooms or dormitories are needed. Often the IICS may have to wait until more pressing needs have been met, however ensuring that schools have clarity on potential savings that could accrue with the IICS is crucial to helping then make the right decisions for the school. The introduction of the National Mitigating Actions-Integrated Sustainable Energy Solutions for Schools in Uganda (NAMAs) alludes to a change in government policy through introduction of a "Clean Cooking Policy "to promote dissemination of energy efficient cookstoves[5].This policy may shift school priorities enabling better IICS penetration.

Timing then becomes crucial. Schools reported that they may be in a position to install "in the future", for example: "when the school starts serving lunch [to students]", "when we construct a bigger kitchen" and "when we have enough savings to get an IICS". This indicates that some schools may be waiting to achieve the right condition to get the maximum value from an IICS as well as saving up to be able to afford one. For these schools, the best strategy may be to approach schools at the "right" time. This can only be done by maintaining regular contact to be able to gauge when the conditions are right. Missing the window may mean other priorities overtake IICS adoption.

> " [We] will Install when school starts serving lunch [to students]."
>
> ADMINISTRATOR, JINJA SECONDARY SCHOOL

3. Awareness

Among schools without IICS, awareness of the benefits of IICS is high, 83% (152) of respondent said they were "… aware of the differences between improved cook stoves and [their] current method of cooking?" with 94% (181) stating that IICS was better than their current mode of cooking and all respondents able to state at least one benefit of IICS.

65% (119) of schools reported direct interaction or visits from practitioners and other actor's promoting IICS. This seems low given that all the schools in the study population are recorded as having been visited by the E4I team. A possible explanation, of the result, is that the staff interviewed may have been unaware of previous contact, and may not have been employed at the school when the promotional visits happened. However there appears to be potential for further awareness raising through more regular direct contact with schools, especially for the 17% of schools that are not aware of IICS benefits. In addition, the approx. 18% of schools who know of IICS benefit but say they have never had a visit, could be ripe for conversion to IICS through a follow up visit.

---

[5] Nationally Appropriate Mitigation Action on Integrated Sustainable Energy Solutions For Schools In Uganda, UNDP, Ministry of Energy and Mineral Development, Uganda. November 2016.

Are you aware of the differences between IICS and your current method of cooking?
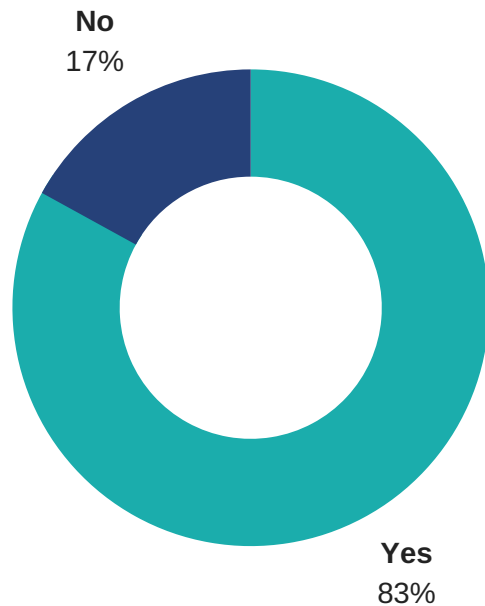
No 17%

Yes 83%

Figure 8: Schools without IICS-awareness of benefits

Have you ever been approached by anyone about installing an IICS?

No 35%

Yes 65%

Figure 9: Schools without IICS- visits for awareness raising

This picture of awareness is not shared by stove manufacturers who believe that sensitisation of schools is the key to unlocking futures sales. In response to "What could help you sell more IICS in schools?" sensitisation was include in 55% (11 out of 20) of responses. Manufacturers included ideas such as brand awareness in the general community, trade fairs for added exposure and educating school administrators.

It should be noted that manufacturers may have been considering the wider school population (all their school customers) when answering this question, not just schools previously approached by E4I. This could explain the divergence in the level of school awareness as reported by schools and manufacturers.

What could help you sell more IICS in schools?

4% 4% 4%
27%
8%
11%
42%

- Funding to schools
- Sensitisation
- Marketing
- Logistics support
- Quality of stoves
- Different payment mechanism
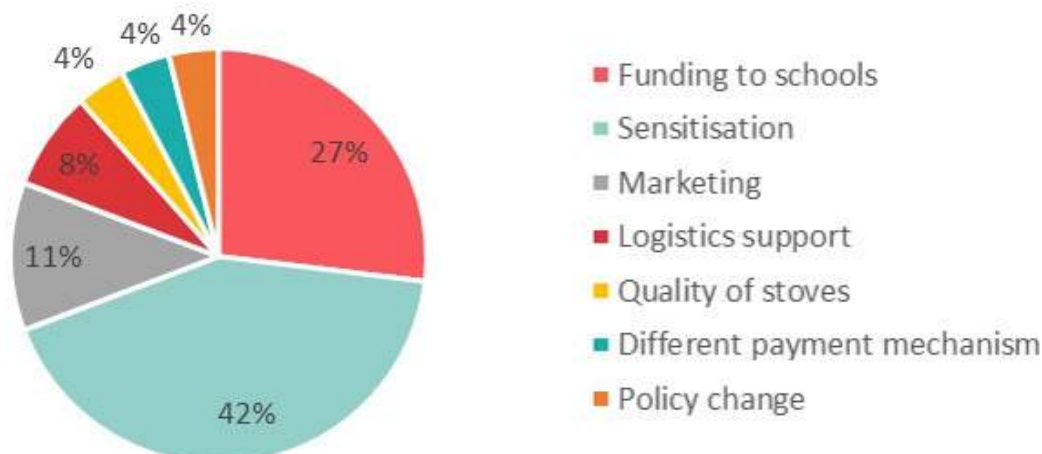- Policy change

Figure 10: Manufacturer's view of awareness as a barrier to adoption

This contrasting representation of awareness could also be as a result of the variety of IICS in the market, with varying quality and messaging, this might leave administrators confused about which manufacturers to trust. Administrators report concern over "fake stoves" and "poor designs" when asked if they had anything to add at the end of the interviews. This lack of trust and potential misinformation may be what manufacturers are encountering as they approach schools.   Independent quality assurance and technology focused messaging from a trusted body may be a solution.

3.3.3 Their future with IICS: perception and aspiration

There is, in general, a positive perception of IICS in schools without stoves. This correlates with the fact that 86% (158) of respondent reported an interest in acquiring IICS, given some support. E4I appears to have played some role in this. Without prompt, when asked if they had anything else to add at the end of the interviews, several administrators mentioned E4I's awareness raising activities at their school in a positive light.

> "Great thanks to Energy 4 impact for visiting our school, we like the IICS and hope to put it on our program in the near future."
>
> JOHN (DEPUTY HEAD TEACHER), MARTIN LUTHER KING COLLEGE

However, the study cannot confirm the extent of the reported E4I outreach as there are concerns over the validity of statements given by study respondents. Respondents who installed stoves from others were equally as likely to say that they heard about IICS from E4I (see Figure 13). This could be from a desire to "say the right thing" to enumerators who identified as contractors of E4I. Studies of surveys in these contexts have shown unreliability of responses can be attributed to interviewees wanting to give the "desirable answer"[6] and to the quality of interviews by enumerators (which is difficult to assure)[7].

There is a sizeable proportion of schools (20%) who want an IICS but who say they do not know where to get one. This proportion (20%) represents approx. 144 schools in the study population.

---

[6] Household Sample Surveys in Developing and Transition Countries, Department of Economic and Social Affairs Statistics Division, United Nations, 2005.

[7] Mark Schreiner, There's no place like Home? : How the Interview Methods Affects Results with the Progress out of Poverty Index, GRAMEEN Foundations, August 2015.

If you wanted an IICS, would you know where to get one from

Would you be interested in acquiring an IICS?
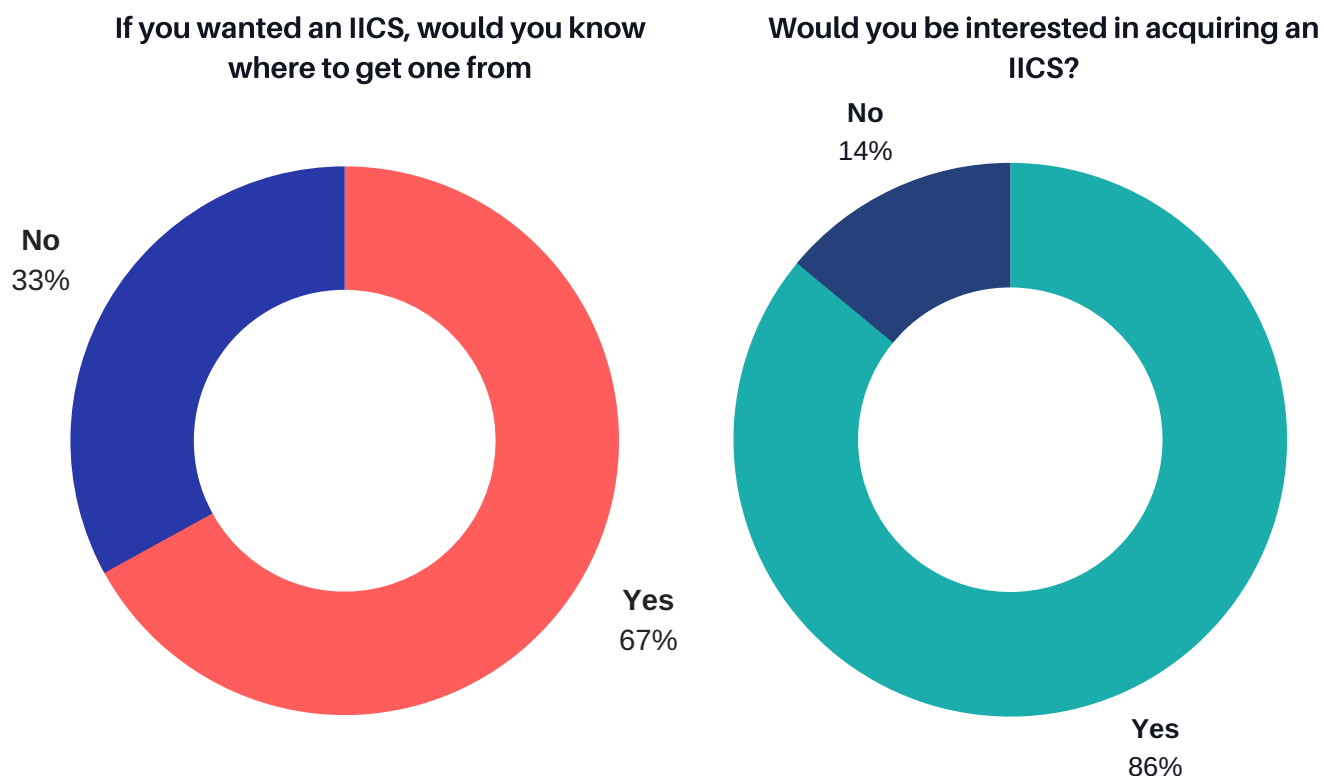
No
33%

Yes
67%

No
14%

Yes
86%

Figure 11: knowledge of sources of IICS and Interest In acquiring IICS

Further study is required for the remaining 460 schools that would appear to be interested in acquiring IICS. Research that is focused on financial barriers and solutions may discover the support mechanisms needed to convert these schools to IICS use.

3.3.4 Summary

- The biggest reported barrier to IICS adoption is cost to schools. IICS are considered expensive and unaffordable by school administrators.

- Other headline barriers include competing school priorities, spread out decision making and inappropriate timing.

- The level of awareness by schools seems to be viewed differently by schools and manufacturers. This may be as a result of manufacturers having a view of many more schools outside the programme study areas, whose awareness levels may be lower. Issues around misinformation due to variety of manufacturers and information sources in the market may also be causing some of the uncertainty.

- There appears to be high appetite for IICS, more than 600 schools in the study area would be interested in acquiring IICS. However, this should not directly be taken as the total market for IICS in the area as other options may be credible alternatives.

3.4 Schools with IICS

3.4.1 When were IICS installed?

The majority of respondents remember installing stoves between 2013 and 2017, the same time as the E4I programmes. 54 out of 148 schools (known to E4I as having IICS through the programme) remembered installation IICS before programme initiation in 2013.
These 54 schools were cross checked with signed Memorandums of Understanding at stove installation. From E4I database information, it was possible to reconcile 51 of the 54 schools as having installed IICS on dates within the programmes duration. This points to a significant degree of mis-remembering of installation dates (36%).

Percentage error - E4I schools reported installation dates
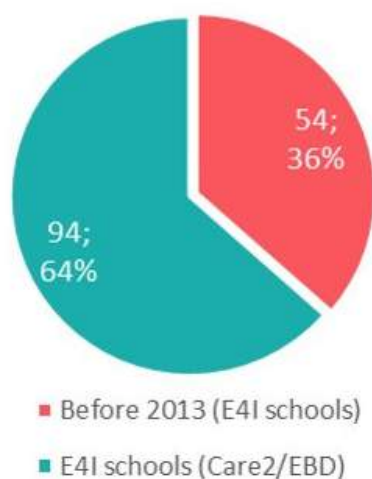
Verified count of IICS installation dates
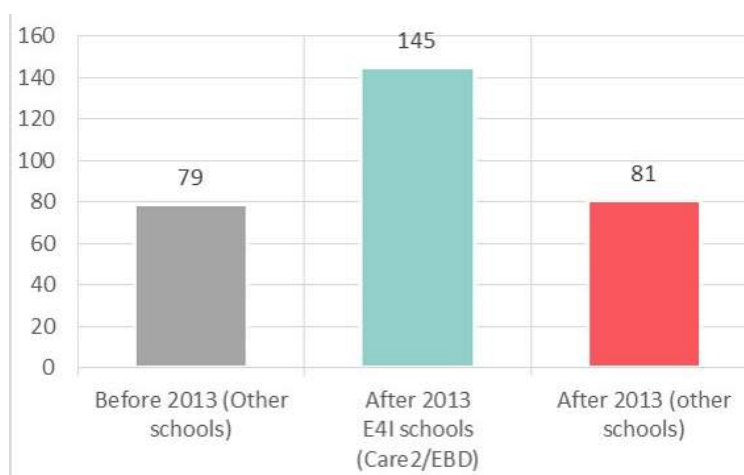
Figure 12: a) Count of IICS installed in programme period b) error margin on installation date data.

The accuracy of the installation date data is compromised, the error margin for E4I schools was approximately 36%. Assuming a similar proportion of non-E4I schools are misremembering when they installed, of the 871 Schools in the population with IICS from others, there are between 286 -596 schools who installed IICS during the period the E4I programmes were running. This is a significant number, and the E4I programme was not aware of this phenomenon during programme implementation.

To understand if any of these school's adoption could be attributed to E4I activity, the study plotted results of where the schools say they heard about IICS from.

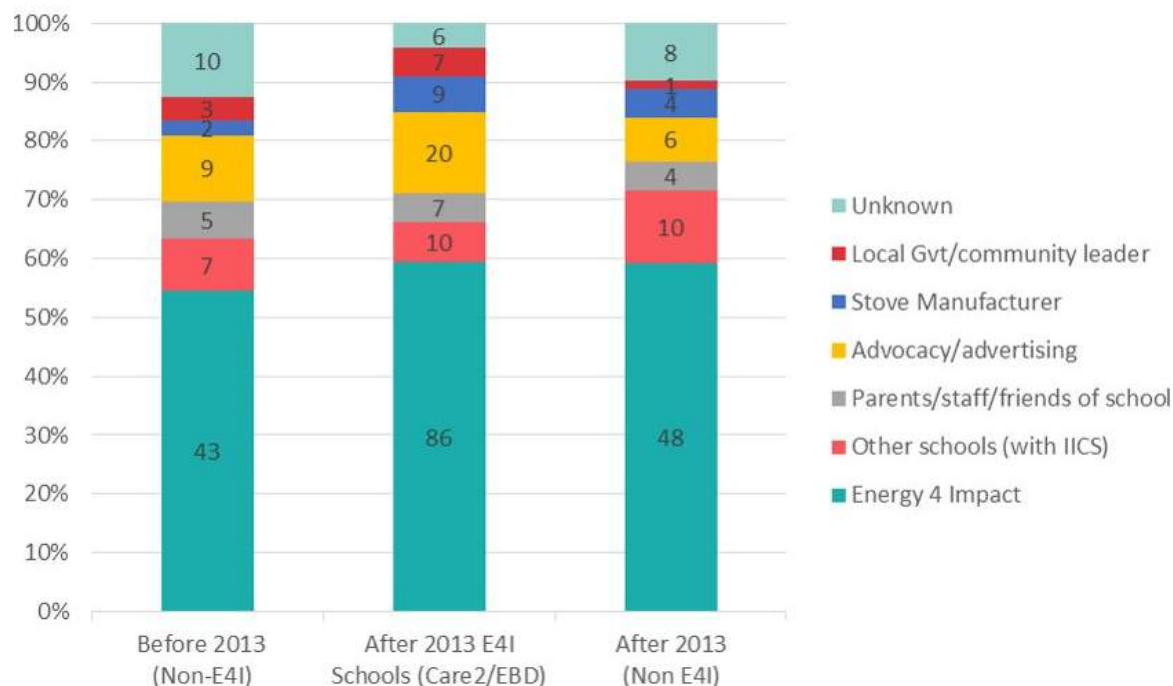**Where schools with IICS heard about and/or received stoves from**

Figure 13: Where schools got information on IICS, E4I vs Non-E4I schools

The proportion of sources of IICS information are relatively equal between E4I and non-E4I schools. This implies that most schools received information about IICS from the same sources. E4I represents a large portion of the information source, suggesting that awareness raising activities by the programmes are reaching a wider audience than previously expected. This is difficult to prove, however, as respondents may be providing answers they think the enumerator wants to hear. Establish the degree of E4I influence on 'non-E4I' schools requires further analysis.

The reporting on where a school heard of IICS from could be due to the following;

- E4I repaired and replaced stoves installed by other manufacturers, some of those stoves had been installed prior to 2013. Schools could be reporting the first incidents of installation by other manufacturers (given that the survey question did not make a specific distinction).
- Various other actors were running IICS programmes at the same time, school administrators may not be able to distinguish one NGO actor from another thus associate the NGO presented to them at the time with IICS. An element of giving the "right answer" as explained in section 3.3.3, may also have played a part.

3.4.2 Cooking features

Schools with IICS, in general, cook 3 or more student meals a day and spend on average up to 3 hours cooking each meal, meaning kitchen staff could routinely spend more than 9 hours in the kitchen. These schools spend more time cooking meals than schools without IICS which may have been a driver for IICS acquisition.E4I schools on average cook more meals and for a little longer than non E4I schools.
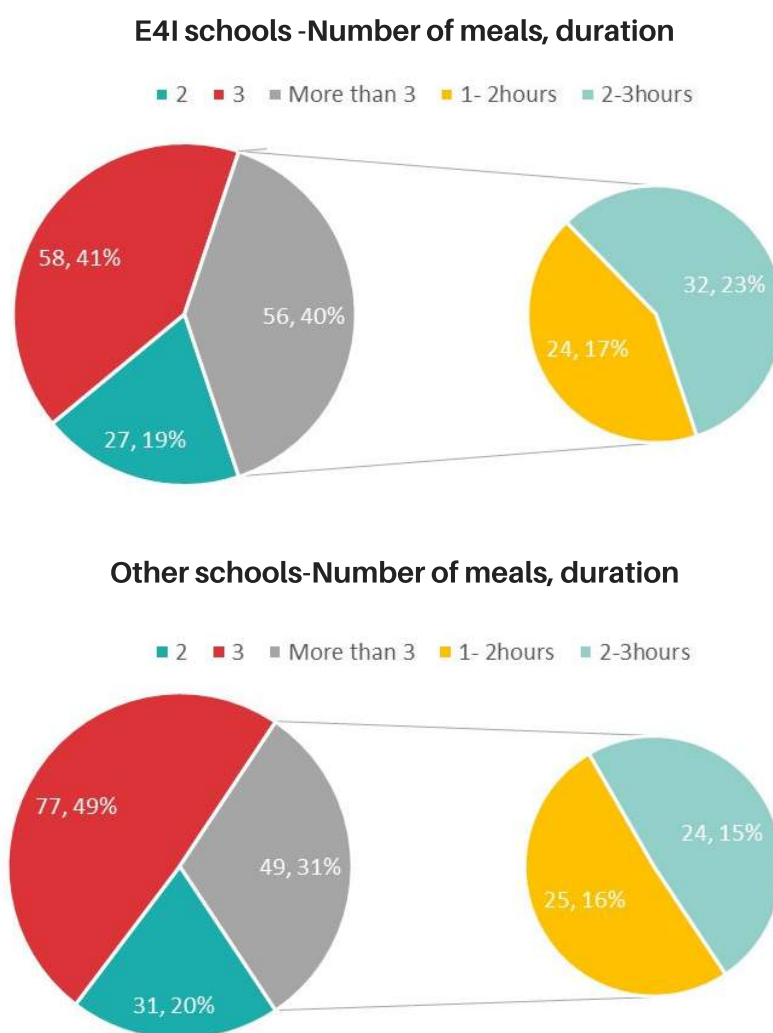
E4I schools -Number of meals, duration

Legend: ■ 2 ■ 3 ■ More than 3 ■ 1- 2hours ■ 2-3hours

58, 41%
56, 40%
27, 19%
32, 23%
24, 17%

Other schools-Number of meals, duration

Legend: ■ 2 ■ 3 ■ More than 3 ■ 1- 2hours ■ 2-3hours

77, 49%
49, 31%
31, 20%
24, 15%
25, 16%

Figure 14: Duration of time in Kitchen, shown by number of meals and duration of each meal

Various factors can affect the frequency and duration of cooking including, type of food cooked, fuel preparation and fuel quality, time taken to light the stoves and consolidation of meals i.e. both lunch and dinner cooked at the same time.

The bulk of the schools that report having IICS use fire wood for cooking (287 out of 305), with the rest using charcoal, briquettes or a combination of these. The firewood is mainly purchased locally (285 out of 305) though some schools supplement this by collecting locally and also asking students to bring firewood to school.

3.4.3 Decision making and priorities

It appears that decisions on purchasing IICS are made collectively involving more than one primary decision maker. 66% (E4I) and 63% (Other) of respondents reported making a consultative decision to purchase, while 9% (E4I) and 6% (Other) made independent, solo, decisions. This may explain anecdotal information, from the CARE2/EBD-Uganda team, that, it takes several visits to a school to come to an agreement on installations. The period between visits may be the decision makers' consultative period. This period might perhaps be shortened by manufacturers/programmes identifying all decision makers at the onset and speaking with all of them collectively.

The biggest draw to IICS for our respondents was cost savings, followed closely by time savings and health concerns.
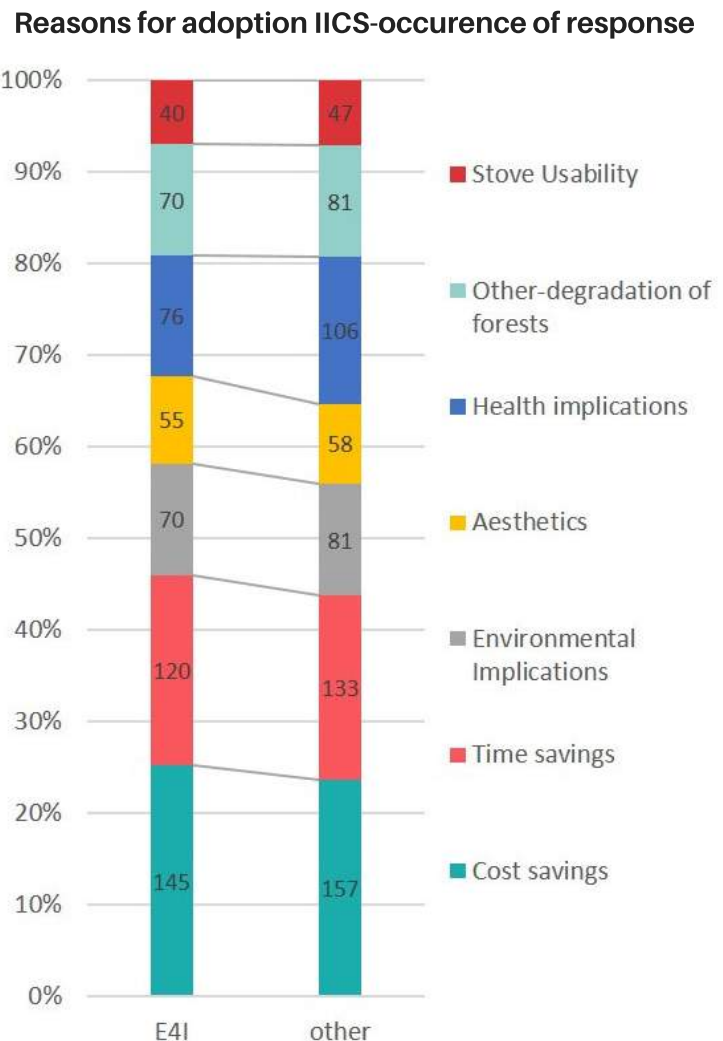
Reasons for adoption IICS-occurence of response

Figure 15: Reasons for adopting IICS

When asked "Why did you chose to install an improved cook stove?" respondents were given 4 pre-set options and a blank space to put in any other reason. Degradation of forest was included in the "other" reasons box in 70 (E4I) and 81(other) incidence, despite a pre-set option of "environmental implications". This suggests that IICS users are acutely aware of the link between improved cooking methods and reduction in destruction of forests.

Awareness raising focused on this message is penetrative and appears to reflect the priorities of the IICS users. As well as E4I, there were other actors in the sector promoting the benefits of using IICS and impacts of traditional cooking methods including the Ministry of Energy and Mineral Development (MEMD), Global Alliance for Clean Cookstoves (Fumbalive), Joint Energy Environment Projects (JEEP- WWF), and GIZ.

3.4.4 The impact of IICS

E4I has documented installation of IICS in 441 schools as a result of programme activity. From the study, we estimate that there are around 871 other schools with IICS, this represents 46% of the "unknown" schools population.

"Unknown" schools population

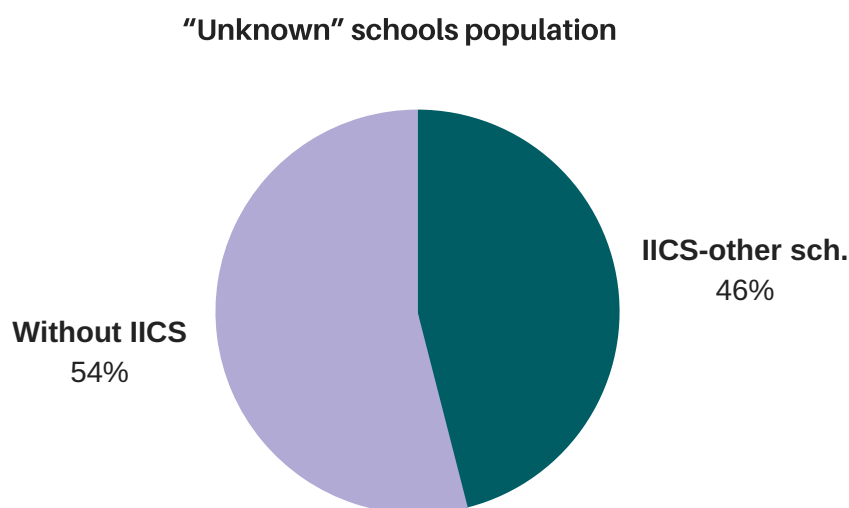

IICS-other sch.
46%

Without IICS
54%

Figure 16: a) Proportion of previously unknown schools that have IICS

Of the 871 Schools, there are between 286 -596 schools who installed IICS in the same time period as the E4I programmes, see section 3.4.1. The proportion of sources of IICS information are relatively equal in all schools, with E4I representing a large portion of the information source (approximately 57%), see Figure 13. This suggests that awareness raising activity by the programme reached a wider audience than previously expected and programme impact may be larger than recorded.

If we attribute the 57% of the schools to E4I, then E4I may have influenced installation in 163 – 340 more schools than recorded. These numbers take into account the margin of error from misremembering. However, there may be other external factors that could erode this additional impact. For example, concurrent programmes from other actors. More detailed study of schools would be required to provide a comprehensive and accurate reporting of E4I impact beyond the 441 schools recorded.

1. IICS usability

Overall schools reported positive usability and benefits of IICS, 80% of responses indicated less smoky kitchens, more than 90% reported time savings, easy lighting and faster cooking. The small percentage of responses indicating increase in smokiness of kitchen correlate with faulty IICS.
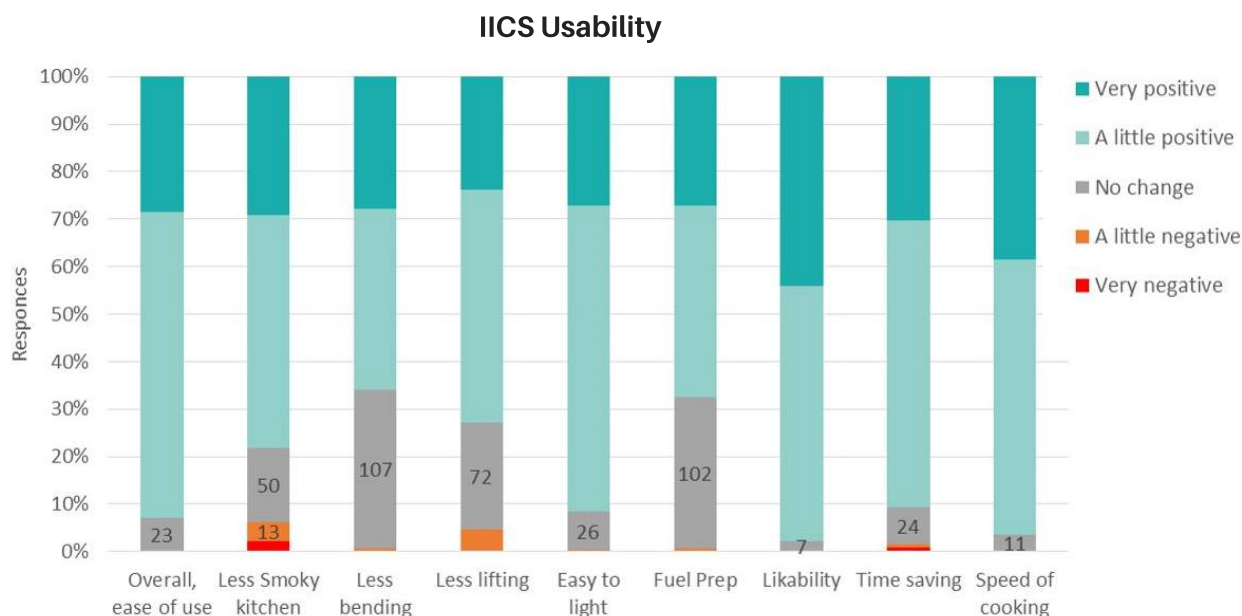
IICS Usability

Figure 17: IICS benefits related to usability

Despite a reported overall positive impacts, two areas stood out for future improvements. More than 30% (102 incidences) of responses highlighted no change in ease of fuel preparation or ease of manual handling. When asked what they liked least about the IICS these items recur. Of those that reported a dislike, 32% (37) cite issues with firewood and 19% (23) reported difficulty in using the IICS, especially due to heavy lifting and height of the IICS. 16% (17) of respondents cite smoke and issues that could contribute to smokiness i.e. Ill-fitting sauce pans and chimney faults.
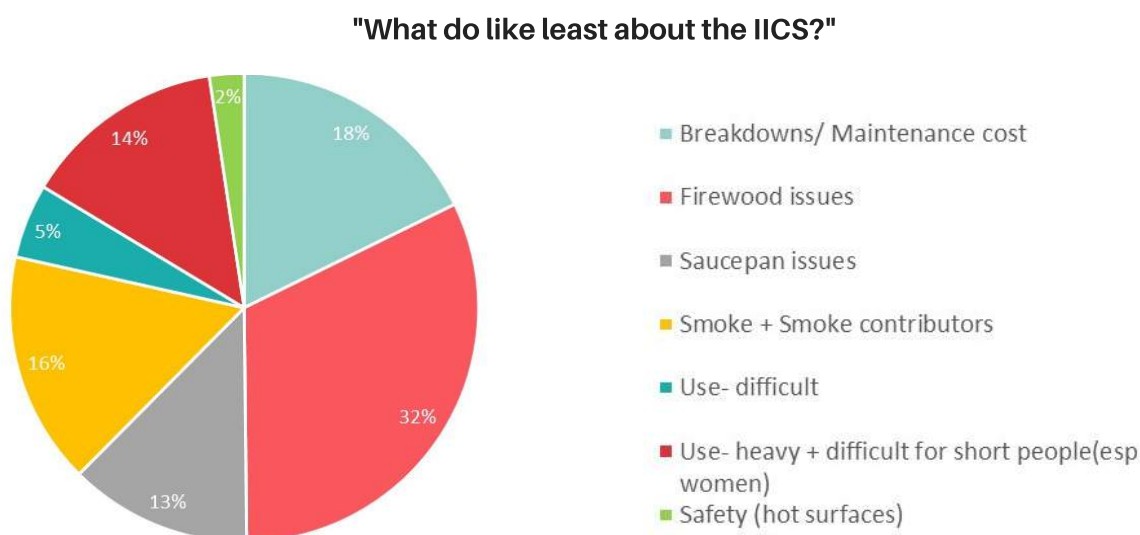
"What do like least about the IICS?"

Figure 18: What do you like least about the IICS?

There seems to be a large proportion of faults with the IICS. One suggestion is that IICS are not being used properly. In a survey of stove manufacturers, they reported that IICSs were being used incorrectly leading to higher incidences of reporting faults. This is despite 88% (275) of kitchen staff reporting to have had training on how to use the stoves. This raises concern over the methodology and timing of training carried out in kitchens with IICS. Other factors may also be at play, including staff turnover which may lead to untrained staff using the IICS. A continuous training methodology that involves school administration may be required.

> "Schools complain about constant breakages, which arise due to poor usage!"
>
> DIRECTOR, RACHELLE UGANDA LTD

2. Cost savings

The majority of cost savings on IICS come from reduction in fuel expenditure. 86% (268) of respondents reported using less fuel since installing the IICS. The average reported cost saving from fuel is UGX 752,125 (USD 226) per school term, representing savings of 42% in fuel costs. Previous research and evaluation from the E4I programme has reported a similar level of saving on fuel cost (50%). These cost savings are one of the largest attractions for schools installing IICS and contribute to affordability of the stove. The table below shows the average cost of stoves by size, as reported by IICS manufacturers.

Table 8: Calculation of stove pay off duration based on median fuel savings

Stove size	Average cost (UGX)	Average cost ($)
100L	1,631,579	450
200L	2,243,750	620
300L	3,060,526	850

Direct correlations of fuel cost saving and payback periods is difficult to calculate and varies from school to school. This is because assessment of fuel savings will be altered by many factors including volume of usage linked to a school's size, durations of cooking, number of stoves installed, type of wood (wet vs. dry), type of saucepans used, and the cooking behaviour/skills of the cooks. Insufficient data is available to enable us to reliably estimate payback times for different sizes of installation. Further study would be required to make correlation calculation, and this would be useful in designing appropriate instalment plans.

This study did not explicitly research available instalment plans and how they are structured. Further work would need to be carried out to understand how instalments are structured and if that can be improved to increase affordability. Clearly stoves can pay for themselves over time, the challenge is financing the initial capital investment and structuring instalment plans that match fuel savings.

What are the schools spending their saving on?

Count of what schools say they spend fuel savings on

Schools report spending money saved on school infrastructure developments and maintenance (28%), buying food and improving the quality of school meals (19%), contribution to the general school budget (14%), salaries (9%) and firewood (8%). The number of schools who explicitly mentioned using money saved on fuel to pay back stove instalments was less than expected. This was surprising given that the majority of stoves are purchased on instalments and awareness messaging by E4I and other stove programmes tends to focus on the ability of IICS to save on fuel costs and use of these savings to payback IICS cost in reasonable time scales.

The absence of explicit mentions of instalment payments may suggest that, despite targeted messaging, school administrators do not see a precise link between affordability of the stove and cost saving generated by the stove. The dissociation could explain the low uptake of bank supported loans trailed by the programme. Schools do not appear to see savings from fuel as a potential source of income, with which to pay off loans or instalments. Examining the association of stove affordability through fuel savings may aid in designing funding structures and value messages that are better received by school administrators.
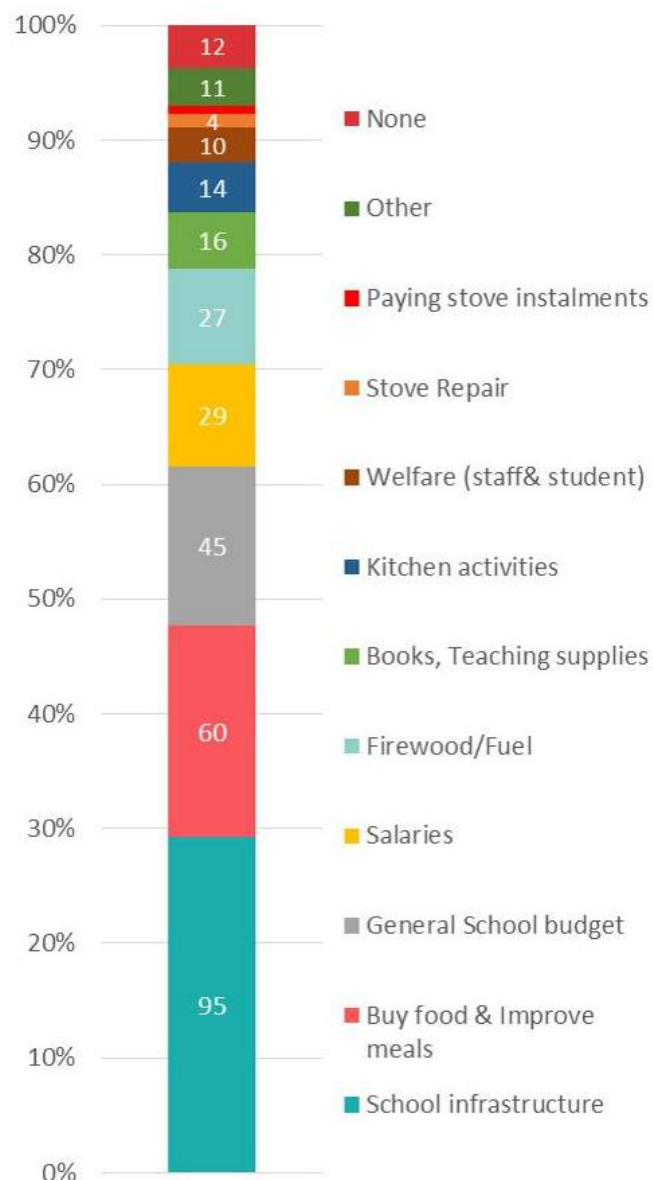

Figure 19: Count of what schools spend their fuel savings on.

A proportion of the saving was also reported to be used to reinvest in the next term's firewood. This implies an element of stockpiling (which would de-risk schools against fuel price hikes). Another implication could be that before IICS, schools were facing particular challenges in fuel affordability which have been relieved by the reduced need for firewood with the IICS.

3. Time saving

Kitchen staff report saving time by using IICS. The majority of respondent (61%-184) reported saving "a little more time".

How much more time are you saving with this stove compared to the old method of cooking?
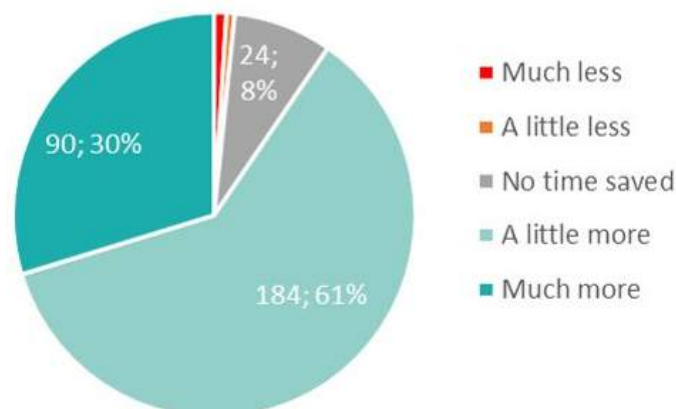

Figure 20: Time savings as a result of using IICS .

The main contributors to time savings seem to be the ease of lighting the stove (90% find it easier) and the increase speed of cooking (more than 90% of respondents reported faster cooking times). Fuels preparation (chopping firewood into smaller pieces) was cited by respondent as an inconvenience, only 68 % of respondents reported "a like easier" or "a lot easier" fuel preparation. This may be reducing the time savings reported from use of IICS.

What are kitchen staff spending their saved time on?

A proportion of time saved by using IICS is invested back into kitchen and food related activity for example, cleaning (26%), food preparation and service (10%), fuel preparation (4%) and other kitchen and school related activity (8%).

A significant proportion of time is spent socially, relaxing and socialising (47%) and a small percentage on personal domestic work. This large proportion of time spent at rest is likely to lead to better staff welfare conditions.
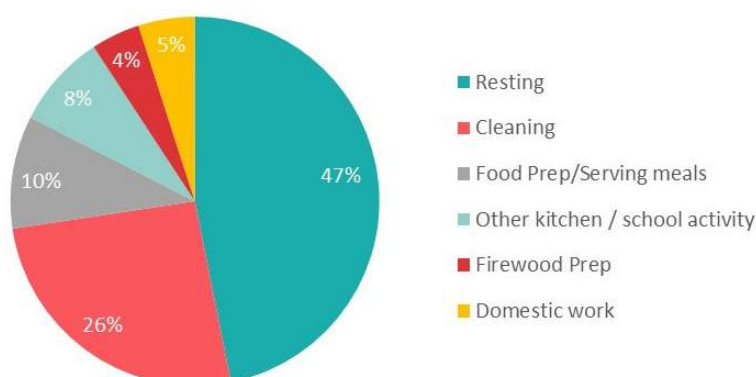
What kitchen staff do with time saved

Figure 21: proportion of saved time spent on other activities
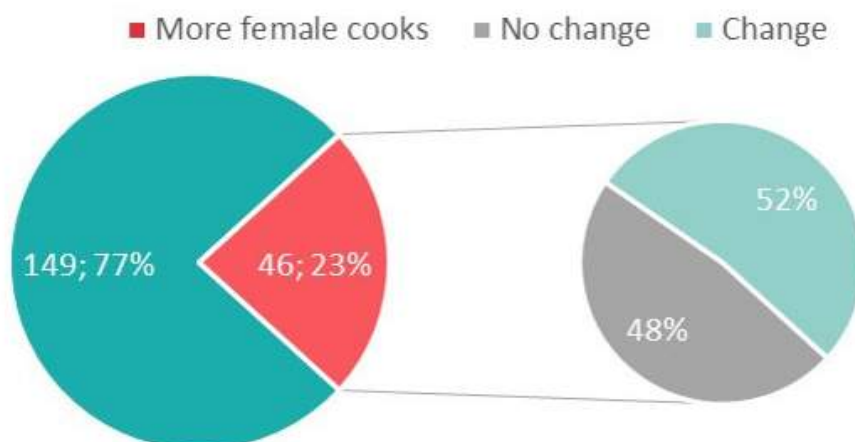
3.4.5 Gender dynamics

Gender dynamics of IICS installation were apparent in this study. On average the gender ratio of kitchen staff is 2:1, male to female. When the gender of kitchen survey respondents is considered, this imbalance is amplified, only 29% (86) of respondents were female. Women were more likely to be the respondent in the survey where the kitchen had staff gender parity. In kitchens with a female respondent the ratio of kitchen staff is 2:2 whilst in those with a male respondent it's 3:1.

The presence of an IICS in a kitchen affects women more than men. Kitchen staff were asked about changes in gender balance since installation of the IICS. In kitchens with more men doing the cooking, there has been proportionally less change than in kitchens where more women are doing the cooking, here there was a lot of flux, more than 50% of these cases resulted in a shift in gender balance in the kitchen.

Has the gender dynamic changed since IICS installation?
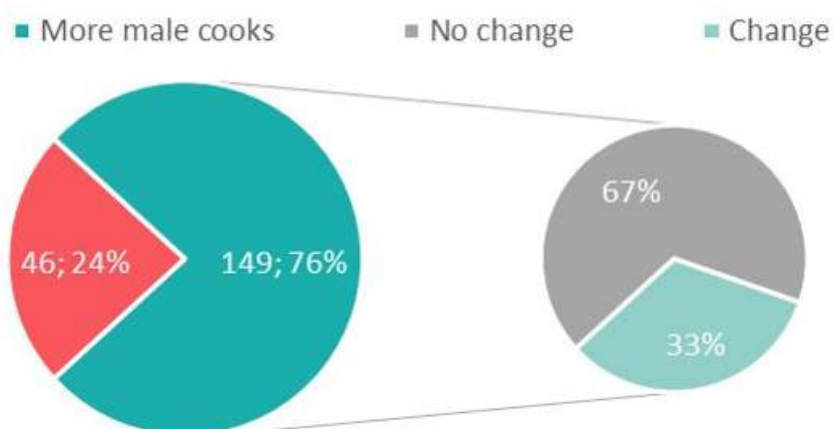
a) Proportion of change in gender dynamics in kitchens that have more male cooks.

b) Proportion of change in gender dynamics in kitchens that have more female cooks

Figure 22: Changes in single gender dominated kitchens, more flux in female dominated kitchens

Technology characteristics and usability

There are aspects in the use of IICS that are more challenging for women, 14% (14) of responses specifically highlighted heavy lifting and height of the stoves being the least liked quality of the stove, see Figure 18. A few responses specifically mentioned that this unfairly disadvantages female cooks. In addition to this, IICS requires splitting of firewood to small pieces, this was highlighted as a difficulty due to the manual labour required. This aspect would also unfairly disadvantage female cooks if they were expected to carry out the same tasks as their male counterparts.

˙Male and female respondents were equally likely to name the disliked stove characteristics and their effect on women, there was no statistically significant difference between male respondents and female respondent.

Use of time spent

There is a noteworthy difference in how male and female kitchen staff (respondents) spent the time they saved from using IICS. Food preparation and service appears to be split equally between men and women with the same parity seen in personal domestic work. Women are slightly less likely to be resting than men.
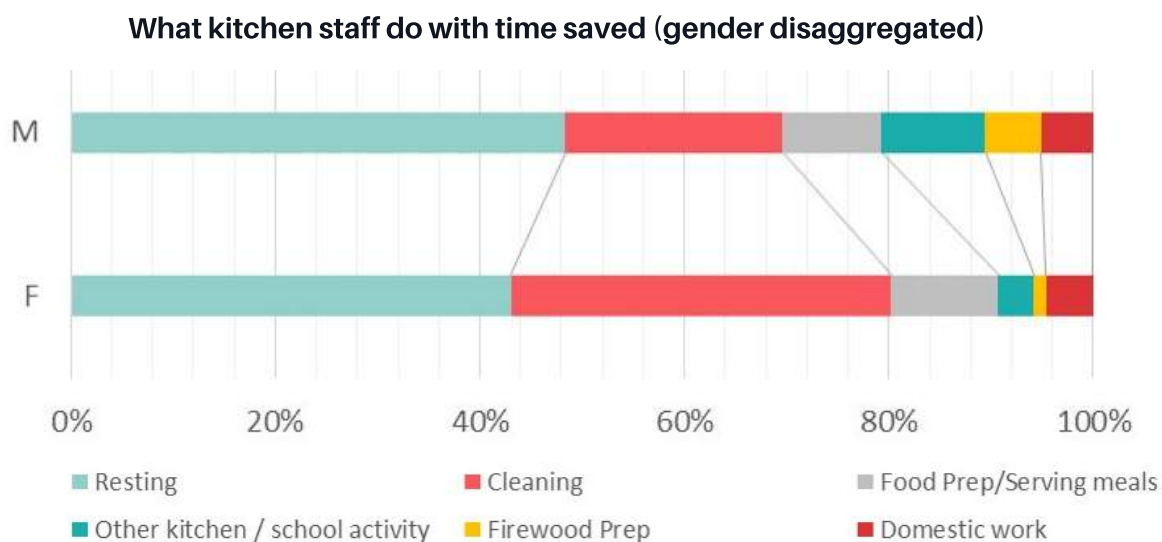
What kitchen staff do with time saved (gender disaggregated)

Figure 23: Kitchen staff report of what they spend time saved on (gender disaggregated)

3.4.6 Summary

- Awareness of IICS attributed to E4I is similar among schools who installed before our programmes began, those who adopted through our programmes, and those who adopted from elsewhere in the same period. This suggest some E4I influence, the extent of which requires further study to quantify.

- At the same time as E4I programs were running, an estimated equal number of schools installed IICS from other sources. This may in part be an effect of the E4I programme but this is difficult to establish with confidence based purely on the survey results.

- The E4I programs have resulted in reported cost saving, time saving, improvement in kitchen conditions and less manual labour. Cost savings are the main driver for the decision to acquire IICS.

- Higher than expected incidences of fault with IICS, attributed to improper use, raises possible questions over the methodology and timing of training carried out in kitchens with IICS.

- Schools have saved more than 40% of fuel costs from installing an IICS.

- For school administrators, there may be little to no association between fuel savings and affordability of cookstoves, which may be a factor in the low adoption rate of credit products seen by E4I programmes.

- There is a definite gender facet to IICS installation, existing stove characteristics may be introducing unfair disadvantages for women cooks. Stove design may need to be adapted to remove this barrier

3.5 Stove Quality and Aftersales Support

Stoves recommended through E4I have marginally fewer break downs since installations (36% -53) compared to those from other manufacturers (41% -65). This difference is not statistically significant, thus no marked quality difference. This may be because the same manufacturers could be selling into schools outside E4I programmes and without E4I's intervention.

The repairs and guarantees process by E4I manufacturers appears to be working better that those of others, a higher proportion of the stoves are repaired by manufacturer (60% compared to 40%, see Figure 24). The recurrence of breakage i.e. more than once, at (20%-30) is less than with other manufacturers (24%-39) though this is not statistically significant.

Who carried out repairs of your IICS?

Have you experienced any other problems with the IICS?

Figure 25: Reported faults on IICS

Figure 24: Who carries out stove repairs
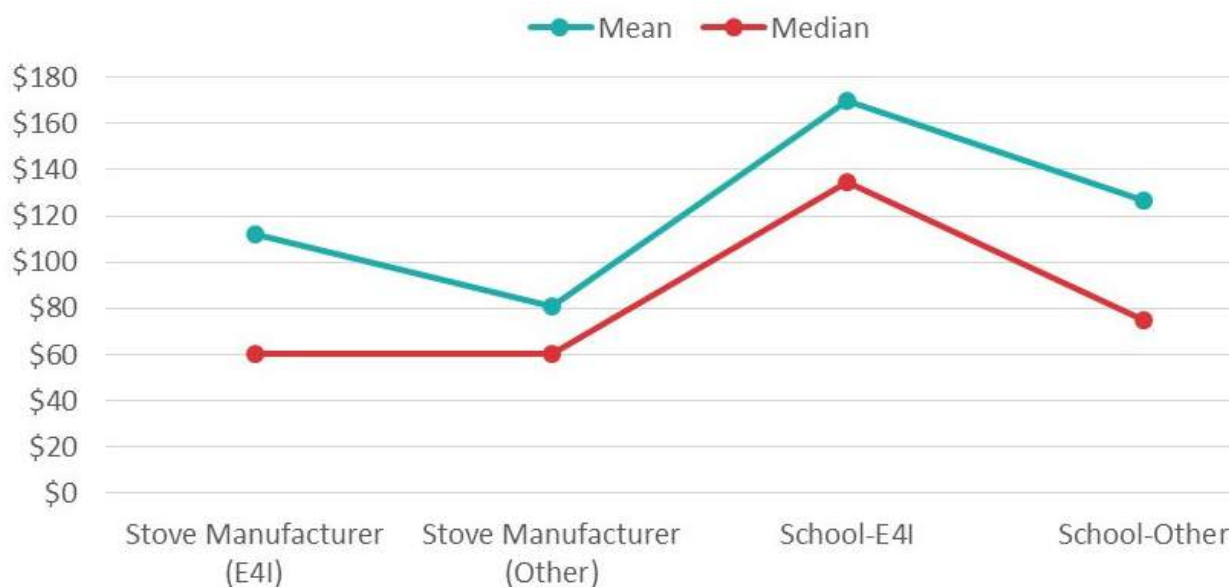
Who carried out repairs of your IICS?

Figure 26: Average repairs costs (manufacturer's vs self-sourced rapiers)

Cost of repair appear to be less where manufacturers carry out the repairs than in cases where schools seek alternative repair arrangements, a difference of approximately $40. More nuanced comparisons may be possible if the types of repairs can be matched to repair costs
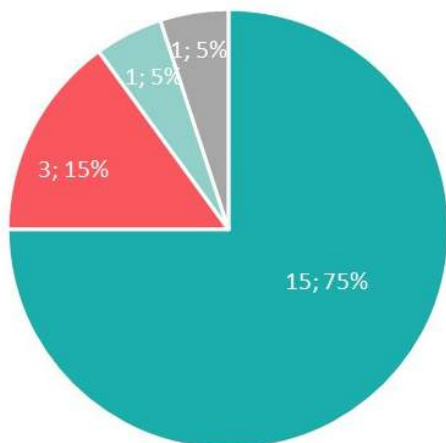
3.6 Manufacturer's View

3.6.1 Demographics

The study interviewed 20 IICS manufacturers, 15 of whom are E4I partners who were recommended to schools under the programme. The companies have been in operation for an average of 10 years and have, on average, 22 employees. They manufacture both portable and in-built IICS with several also manufacturing smaller household stoves. The stoves produced range from 50-500 litres and the companies concentrate on schools as their main customers (75%-15).

On geographic focus, 7 respondents showed no particular target geographies, indicating that they looked to sell across the country, the largest proportion (9) target the Kampala and central district regions with a few companies targeting the rural remote.
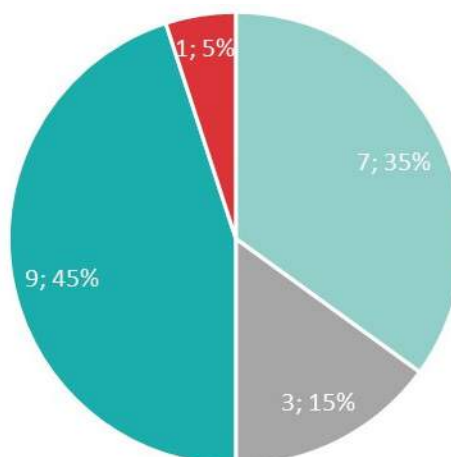
The companies have mixed staff profile with equal representation of sales, marketing, fabrication and installation functions. All the companies had an aspiration to grow staff count.

Who are your main customers?   **What is your target area?**

Figure 27: Main customers and target geographies for IICS manufacturers

3.6.2 Perspectives on schools as customers

In general IICS manufacturers report that they are successful at selling IICS to schools (13 out of 20). Successful manufacturers mostly attribute it to having better quality products and schools realising the benefits that can be accrued from installation.

The main challenge to higher acquisition rates for IICS in school is reported to be awareness. IICS manufactures report that more sensitisation in schools would help then make more sales., see Figure 10. Possible cases and potential solution are explore in section 3.3.2

> ""The administrators do not know the difference between IICS and traditional stoves."
>
> OPERATIONS MANAGER, BBS CONSTRUCTION LIMITED

The second challenge is finance. Of the manufacturers who do not consider themselves to have been successful at selling IICS to schools, the majority cite delays in payments from schools as the main contributing factor. Better funding opportunities for schools are seen as the solution. Stove manufacturers suggest cheaper loans to schools, price subsidies and alternative payment mechanisms.

The majority of stove manufacturers believe the demand for IICS in schools remains high or very high (18), and that the main demand region is in and around Kampala (14).

3.6.3 Business challenges

IICS manufacturers are facing a variety of business challenges the principal of which is lack of finance. The survey question asked allowed multiple answers and lack of finance appeared in 15 out of 20 responses. Manufacturers offer sales via instalments and most schools take this option over cash sales, manufacturers report difficulty in collecting repayments and delayed repayments. The inference is that by relying more and more on sales by instalments then encountering repayment delays, manufactures are likely to face steep working capital constraints that can paralyse their enterprises.

The second most pressing business concern is logistics, specifically transportation. IICS construction demands large scale and frequent transportation of material and installation teams, for capital constrained businesses this is a challenge as they cannot afford their own vehicles and rentals are expensive.
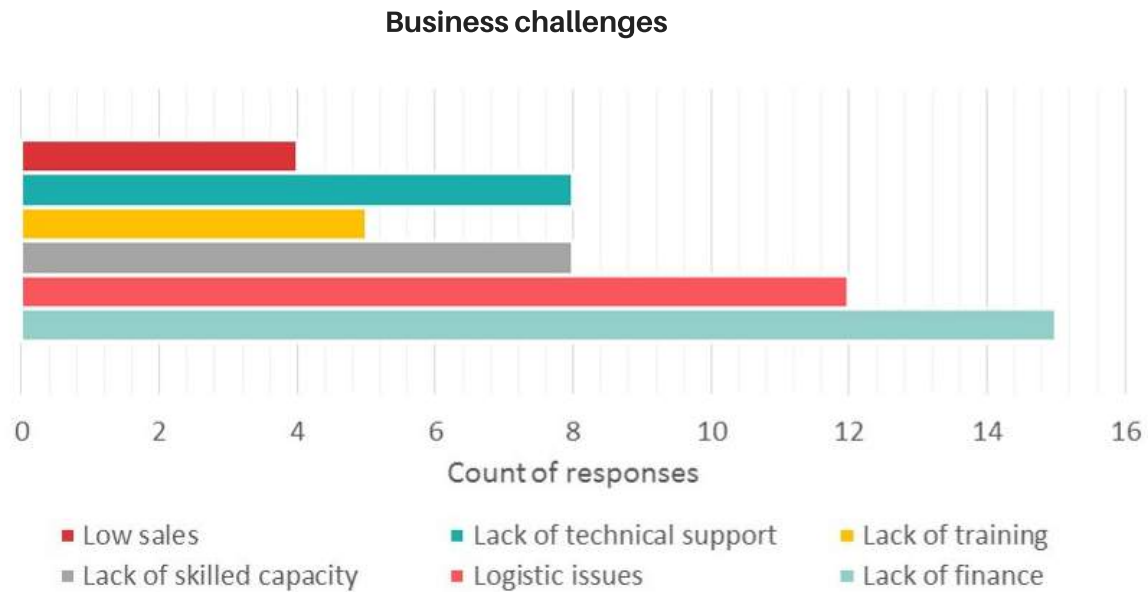
Business challenges

Figure 28: Challenges faced by IICS manufacturers (occurrence in responses-out of 20)

3.6.4 Capacity gaps

Lack of skilled capacity and technical support are equally challenging for IICS manufacturers. The main resource gap is seen as sales and marketing followed by installation then fabrication teams. The desire for sales and marketing staff reflects the challenge of acquiring schools as customers. Manufacturers may be realising that more intensive sales and marketing may be the key to IICS conversion in schools.

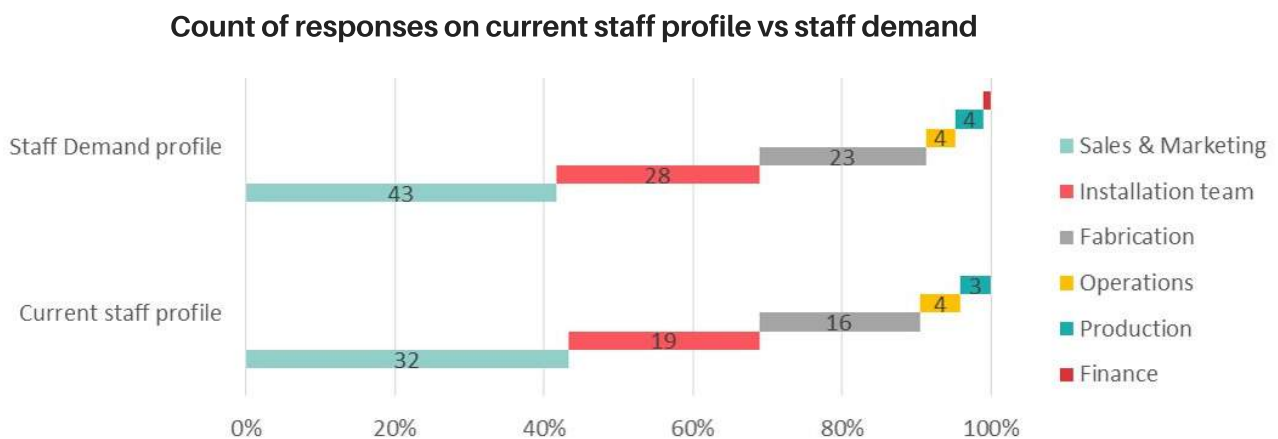**Count of responses on current staff profile vs staff demand**

Figure 29: IICS manufacturers current staff profile vs staff demand profile

From Figure 29, it's clear that IICS manufacturers do not wish to change their staff proportion, they want to increase numbers. The desire for more people to make stoves and more people to help sell them reflect their perception of high demand for IICS in schools.

3.6.5 Loans

Seven of our 20 respondents reported to have requested a loan in the past. The loans were intended to be used for business expansion (specifically production and buying of materials), to help fulfill government contracts and to carry our marketing and sensitization activities. Four of the 7 loans were granted, two by bank, one by a SACCO and another by an MFI. The average loans size was UGX 13,120,000 ($ 3936) and all the loans have already been repaid.

The desire for working capital is strong with half of the manufacturers considering a loan though only 6 seem to be actively seeking one. The high proportion of enterprises that "maybe" looking for a loan may indicate that businesses are cautious about loan products.

CONCLUSION

CONCLUSION

Adoption of IICS in the study area is higher than anticipated. 56% of schools in the region have IICS and there is a high appetite for adoption among the remaining 44%.

IICS have had beneficial impact in schools, and this is being directly observed and reported both by administrators and kitchen staff. Cost saving are the most significant benefit for administrators and are derived mainly from saving in expenditure on firewood. 42% of firewood costs are saved by using IICS.

Some unintended effect of IICS including stove characteristics that disproportionately affect women need to be considered in more detail. Additionally, higher than expected incidence of faults with IICS need to be investigated further. The training of staff may need to be redesigned to reduce improper stove usage that has been linked to faults.

The major barrier to acquisition of IICS for schools, is cost. Schools may not see the link between fuel savings and IICS affordability despite sales approaches which have a clear translation of fuel saving into payments for the IICS. For practitioners access to capital is also a challenge, they are unable to offer credit to more than a few customers at a time. Even with more capital, however, credit management could become an issue, as delayed repayments jeopardise business operations.

There are nuanced issues in the area of customer awareness. Schools report high levels of awareness yet manufacturers do not share this view of schools, believing schools need more awareness raising to increase IICS adoption. Manufacturers serve a wide range of customers including those outside areas of focused sensitisation by the programme. Moreover, the large variety of products of varying quality (all under the same umbrella of IICS) may be confusing administrator leading to distrust of IICS. Quality assurance or standards are an obvious solution. In the meantime the role of independent advocates of IICS such as E4I is crucial in gaining customer trust, recommending quality manufacturers and providing independent awareness raising on the benefits of IICS.

E4I has played a significant role in the adoption of IICS in this region, this is indicated by the study though the unreliability of data on periods of installations and sources of awareness makes it difficult to quantify additional impact. The programme's M&E process captured relevant data used by the study to verify discrepancies and confirm some results. Given adequate resources this database could have been interrogated during the programme's lifetime to give valuable insights into trends that might have shaped programme activities.

The challenges of reliable data collection in this context have been evident and have led to the omission of several data sets. Steps were taken at study design to mitigate this risk including training of enumerators, design of simplified questions, and use of visual information for clarity. However residual issues persisted and may have been amplified by study duration constraints. Other mitigations that can be included for future studies include, more intensive training of supervisors as well as enumerators, closer supervision of enumerators, reducing work load and making available sufficient study duration to improve interview quality.

E4I's programme has provided independent advocacy for IICS and endorsement of trusted stove manufacturers whose quality and aftercare standards are confirmed by study results. There is a continued need for this type of service to maintain customer trust in the technology thus increasing adoption rates. E4I's programmes also establish longer term relationships with schools. These continuing relationships are necessary to counter the timing and decision making barriers for schools by bringing stakeholders together and making connections to manufacturers as soon as schools are ready.

Acknowledgement

The study authors wish to acknowledge with much appreciation
the crucial role of the staff of the E4I Uganda office, who gave
their support and feedback throughout the study process.

For more information, please contact:

Makena Ireri
Email: makena.ireri@energy4impact.org
Tel: + 44 207 242 8602
Fifth Floor - Totara Park House
34-36 Gray's Inn Road
WC1X 8HR
London, United Kingdom